Flipping Physics Lecture Notes:

Introduction to Conservation of Momentum

- Remember, the equation for momentum is $\vec{p} = m\vec{v}$.
- Momentum is conserved in an "isolated system".
  - A system is isolated when the net force on the system equals zero.
  - $\sum \vec{F}_{system} = 0 = \frac{\Delta \vec{p}_{system}}{\Delta t} \Rightarrow 0 \cdot \Delta t = \left(\frac{\Delta \vec{p}_{system}}{\Delta t} \right) \Delta t \Rightarrow 0 = \Delta \vec{p}_{system} = \vec{p}_{f\,system} - \vec{p}_{i\,system} \Rightarrow \vec{p}_{i\,system} = \vec{p}_{f\,system}$
- In an algebra based class this means *momentum is conserved during all collisions and explosions*.
- Conservation of Momentum means the sum of the initial momentums of the system before the collision or explosion equals the sum of the final momentums of the system after the collision or explosion.
- The equation for Conservation of Momentum is $\boxed{\sum \vec{p}_i = \sum \vec{p}_f}$

The skateboard example:

- The velocity of mr.p before the explosion is zero; therefore mr.p's initial momentum is zero.
- The velocity of the ball before the explosion is zero; therefore the ball's initial momentum is zero.
- The total momentum of the system initial is zero. $\sum \vec{p}_i = \sum \vec{p}_f \Rightarrow 0 = \sum \vec{p}_f = \vec{p}_{hf} + \vec{p}_{bf}$
  - "h" is for "human" because "p" for mr.p would be too confusing.
- The ball has a velocity to the right after the explosion; therefore the ball has a positive momentum after the explosion.
- Because the ball has positive final momentum and the total momentum is zero, mr.p must have negative momentum after the explosion. This is why he moves to the left.
  - $\vec{p}_{bf} > 0 \Rightarrow \vec{p}_{hf} < 0$